Shower library technique for fast simulation of showers in calorimeters of the H1 experiment

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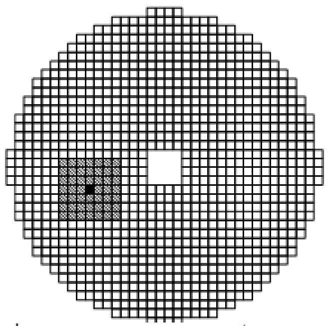
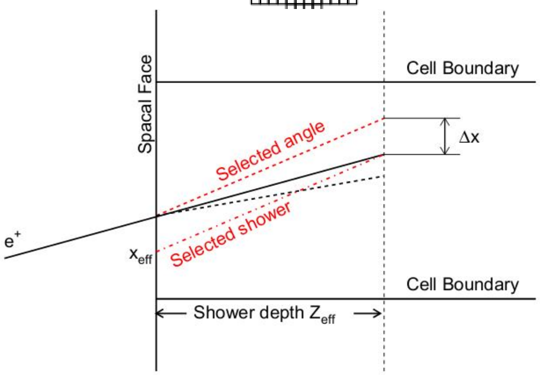
- Shower library (SL) - presimulated sets of showers - to improve and speedup shower simulation



- Contains energies in a box around the hottest cell
- Binned logarithmically in energy , linearly in impact position inside the hottest cell and impact angle
- Translational invariance used to place showers for different hottest cell



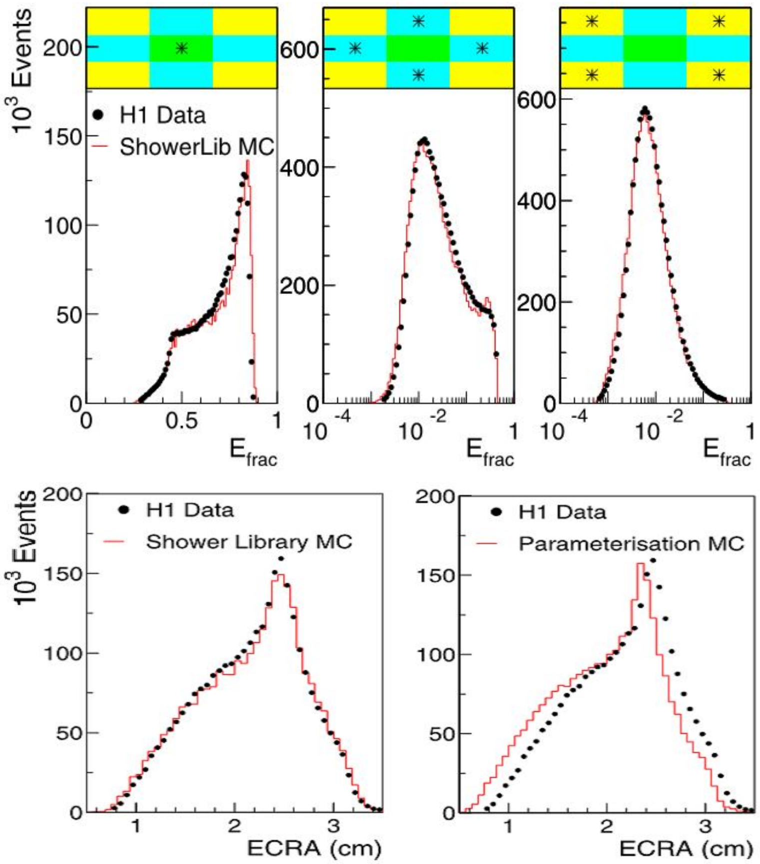
- The shower library is used at the calorimeter face.
- The shower position is corrected for the difference between the incident angle and the shower library angular bin using effective shower depth Z_{eff} (measured in full simulation)

5	5	6	8	6	5	5
5	10	10	12	10	10	5
6	10	20	20	20	10	6
8	12	20	24	20	12	8
6	10	20	20	20	10	6
5	10	10	12	10	10	5
5	5	6	8	6	5	5

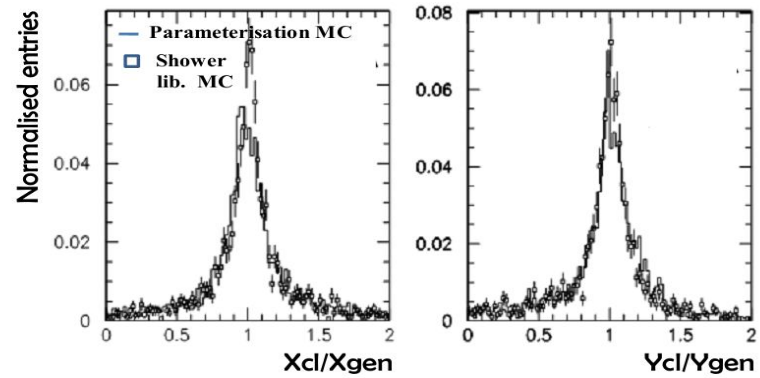
- Store showers as total energy and fractional energy in each cell
- Use bit packing for fractional energy (optionally: in log E_{cell}/E_{shower})
- Keep packed showers in memory, unpack only during usage of the shower
- Group showers in buffers. A buffer contains several copies of complete shower library. Keep one buffer in memory, read new one after recycling same showers few times

- MC simulation based on shower library performed for two lead/ scintillator-fiber calorimeters of H1: backward calorimeter SpaCal and Forward Neutron Calorimeter (FNC)

SpaCal (electron candidates)



FNC (neutron candidates)

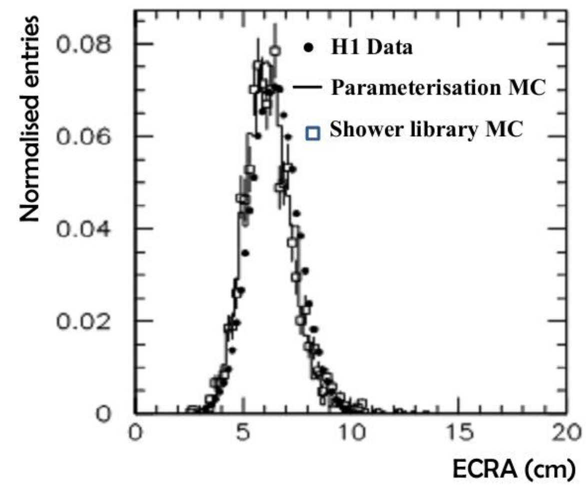


$$X_{cluster} = \Sigma_i x_i w_i$$

$$Y_{cluster} = \Sigma_i y_i w_i$$

$$w_i = \frac{\sqrt{E_i}}{\Sigma_j \sqrt{E_j}}$$

$$ECRA = \Sigma_i R_i w_i$$



- MC simulation based on SL provides good description of the shower profile in SPACAL, better than MC simulation using the GFLASH based shower parameterisation . For the FNC, both simulations provide fair description of the shower profile
- GFLASH becomes less efficient for detectors with large amount of material in front of the calorimeter
- The CPU time for MC based on SL is reduced compared to the full GEANT simulation by about factor of 10 depending on event topology